E. Technology Review

A thorough technology review was carried out in order to answer three major questions: 1) what are the critical areas of technology that are required for PM USA R&D to meet its five year strategic and operational objectives; 2) which of these critical technologies are currently being developed at PM USA R&D; and most importantly, 3) which critical technologies need to be developed. The detailed results of this review are outlined in Appendix B. Also given in Appendix B is a list of PM USA R&D Collaborative Research Programs for 1990 and 1991, and a list of consultants for the same two years. Critical technologies in five key areas are briefly summarized below.

1. Technologies required for manufacturing and production of cigarettes.

Critical technologies identified in the area of manufacturing of cigarettes include visual and optical inspection techniques, techniques for increasing machine reliability, in situ process control, machine flexibility, robotics and machine intelligence, and packaging technology. The Optical Processing Program has been in place for a number of years developing technology in the area of visual and optical inspection techniques, and the first system designed at R&D, Osiris, is now being evaluated in our factories. Some work is presently in progress in the remainder of these areas. The need for expansion of our efforts devoted to these areas in the future will be evaluated in 1992.

2. Materials synthesis and processing technologies.

New materials are being developed daily to meet the demands of new products in the market place. Materials synthesis is the development of new materials or novel techniques to produce familiar materials. Materials processing is the preparation, forming, and shaping of raw materials into finished objects. The critical new materials areas involve adhesives and filter materials. The initial R&D study involving adhesives has as its objective developing adhesive specifications based on a thorough study of adhesive ingredients. This study will be completed by the end of 1992. New filtration materials are anticipated to play an increasingly important role in the development of products with increased impact at low tar levels and selective control of gas phase smoke. Work in both of these areas is ongoing in the Filter Technology Program. In addition, we have recently signed a major agreement with Hoechst Celanese which should make new filter technologies available to us. The last critical technology area involves tobacco processing. PM USA R&D needs to continue to aggressively develop new tobacco processing techniques to be able to reduce manufacturing costs.

3. Technologies required for the solution of environmental problems.

Critical technologies in this area include emissions reduction, development of new crop protection agents, fumigation methodology, waste management, and streamlined techniques for analysis measurement and detection. All of these areas are currently being investigated at PM USA R&D. Two major concerns should be noted. The first is that the allowed level of crop protection residues may be significantly lowered within the EEC. Maleic hydrazide stands out as a particular potential problem. Secondly, the demand on the Analytical Research Division is expected to increase significantly over the plan period as a consequence of environmental programs. Streamlined methodologies will have to be developed to handle this increased load.

4. Technologies required in the sensory area.

Critical technologies identified in the sensory area include receptor-substrate interactions, psychopharmacology, pharmacokinetics, computer modelling, and neural networks. The development of many of these technologies will be carried out in the new Sensory Technology Program.

5. Technologies required for the development of unique smoking articles.

This area potentially requires the largest number of critical technologies, because there are a large number of different types of unique smoking articles which can be envisioned. A partial list of new technologies would include batteries, fuels, microelectronics, aerosols and aerosol generating devices, OV/chemical sensing devices, high speed machine design, specialty materials, and microfabrication. Some of these technologies are being developed for the Beta Program. Because of the increasing numbers of nicotine delivery systems being marketed as "smoking cessation devices," however, it is likely that PM USA R&D will be working on additional types of unique smoking articles during the plan period. This issue will be discussed in detail under Strategic Goal 5. As a consequence, it is likely that this list of strategic technologies will expand.

Technology Assessment

A. Introduction

A strong and continually improving technology base is an element which is essential for a business to remain competitive in today's environment. Technology grows at an ever increasing pace, and as we move continually closer to a global economy, technology can originate from any part of the world. It is no longer sufficient to be aware only of technology developed in the United States. It has been, and continues to be, a difficult assignment to manage technology at PM USA R&D. Considerable effort has been devoted to technology assessment and management during the writing of the 1992-1996 PM USA R&D Strategic Plan, and the sections below summarize this work. The first section briefly summarizes an organizational framework for categorizing key technologies which is based on the "Report of the National Critical Technologies Panel," issued in March, 1991. The second section deals with information gathered at PM USA R&D relating to those areas in which new technology is most important in order to accomplish our mission and the successful establishment of a cross-functional technology assessment committee. The third section outlines new technology achievements at PM USA R&D in 1991, while the last section discusses the leveraging of the technology base of PM Companies through technical synergy.

B. Organization of Technology Classes and Definitions

1. Introduction

Key technologies to PM USA have been divided into six categories; namely, manufacturing, materials synthesis and processing, environmental, sensory, unique smoking articles, and information and communication technologies. Each of these technologies is briefly discussed below. Specific examples of emerging technologies and strong technologies at PM USA R&D are given for each category. Emerging technologies are those not yet embodied in products, services, or processes, but with clear potential for application when fully developed. Strong technologies are those now widely used in products, services, or processes.

2. Manufacturing Technologies

Manufacturing technologies include the development, design, and integration of machines, computers, processes, and humans to cost effectively produce and manage the production of high quality cigarettes.

a. Emerging Technologies

(1) Machine Intelligence - Computer controlled equipment capable of performing a wide range of manufacturing processes (machine inspection, testing, handling, packing) with the use of sensory feedback and suitable man-machine interfaces.

(2) In Situ Process Control - The use of sensors (vision, temperature, position, etc.) and control systems coupled with expert systems to monitor and actively adjust the on-line manufacturing process.

(3) Machine Reliability - The study of machine dynamics and performance for the development of diagnostic analytical methods, design modifications, and predictive maintenance programs for the improved efficiency of manufacturing machines and operations.

(4) Computer Integrated Manufacturing (CIM) - This technology integrates process, product, and manufacturing management information into a single interactive network that greatly reduces the number of transactions necessary to produce a product.

b. Strong Technologies

(1) Vision/Optical Inspection - High speed imaging and analysis for real-time product inspection.

(2) Machine Design - Design and development of tobacco-related machines involving cigarette manufacturing and primary processing.

(3) Tobacco Processing - Equipment development for the preparation and conditioning of tobaccos for the highest quality and optimum utilization.

(4) Quality Control - An aggregate of activities (design analysis and statistical sampling with inspection for defects) designed to ensure optimum quality.

3. Materials Processing and Synthesis

Materials processing and synthesis is the preparation, forming, and shaping of raw materials into finished products through the development of new materials and novel techniques.

a. Emerging Technologies

(1) Adhesives - The development of adhesive specifications based on a thorough study of adhesive ingredients with the ultimate goal of designing new adhesives by relating adhesive performance to adhesive properties.

(2) Filter Materials - Technologies that will allow for the development of products with increased impact at low tar levels and selective control of gas phase smoke.

(3) Packaging Materials - Development of inert materials that will maintain or increase product shelf life with consideration for environmental issues.

(4) Catalysts - Development of low temperature catalysts for CO oxidation and catalysts which can be incorporated into cigarette paper which can alter the chemistry of sidestream smoke.

b. Strong Technologies

(1) Tobacco Processing - Tobacco material development for improved mechanical properties for optimum utilization and improved subjectives.

(2) Natural Binders - Improved binder systems for tobacco or sheet materials.

(3) Papers - Development of proprietary papers with improved ash appearance, puff count control and sidestream reduction; development of rational paper specifications based on cigarette specifications.

4. Environmental Technologies

Environmental technologies encompass all of the technologies required to eliminate, remediate, and process wastes for compliance with federal, state, and local regulations.

a. Emerging Technologies

(1) Emissions Reduction - Reduction in the use of raw and/or finished materials, and procedures that result in reduced emissions from the manufacturing process. Reduction of "pollution" at its source, most commonly the manufacturing process, and the implementation of improved manufacturing practices.

(2) Fumigation Methodology - Development of techniques to determine application of agents for the protection of tobacco; methods for the determination of crop protection residues on tobacco; methods for the measurement of fumigant levels in the atmosphere; and development of models to predict or verify the concentration levels for a given fumigation configuration plan.

(3) Waste Management - Management and processing of pollutants that must be discarded or warehoused in a way to minimize dangers to the environment.

(4) Biodegradable Materials - Development of materials in both the product and packaging that will degrade more rapidly in the environment than is the case for present materials.

(5) Recyclable Packaging - Development of packaging materials that are based on single materials so that they can be recycled without the need to separate components.

b. Strong Technologies

(1) Water-Based Flavor Formulations - Development of water-based flavor systems to replace ethanol-based systems.

(2) Entomology - Study of insects and their reaction to pesticides; bio-engineering techniques to control undesirable infestations.

(3) Microbiology - Minimization of biological activity in tobacco sheet products and waste water through physical separation, electrical component separation, and microbial transformation.

5. Sensory Technology

Sensory technology is the development of a fundamental understanding of those physical, chemical, and biological system interactions that result in a subjective response to a product.

a. Emerging Technologies

(1) Biochemical Techniques Related to Sensory Response - Development of a quantitative description of the receptor-substrate interactions responsible for subjective response to cigarettes.

(2) Flavor Encapsulation - Release systems based on incorporation of flavor compounds in a thermally labile encapsulant.

b. Strong Technologies

(1) Filtration Mechanisms - Physical or chemical processes to remove vapor and/or particulate components from smoke or air.

(2) Flavor Release - Preparation of compounds incorporating flavors which will release the desired flavors on heating.

(3) Flavor Formulation - Formulation of mixtures of natural or synthetic compounds to produce desired subjective responses.

6. Unique Smoking Article Technology

Unique smoking article technology encompasses those areas directed toward the development, design, and manufacture of unique smoking products.

a. Emerging Technologies

(1) Energy Sources - The development of small, powerful batteries to power unique smoking articles.

(2) Aerosols - Technologies involving the development of techniques to control aerosol generation and aerosol physical properties.

(3) Microelectronics - The development and design of integrated circuit chips that have improved performance and resistance to corrosion and heat.

(4) High Speed Machine Design - Development of "intelligent" machinery capable of assembling and inspecting a mechanical cigarette type device at speeds that will make a unique smoking article a viable business venture.

(5) Specialty Materials - Development of insulating and conductive materials to be used for the design of semiconductors and cartridges.

(6) Microfabrication - Technology which involves the fabrication and manipulation of materials and objects on a microscopic level. This technology includes etching, lithography, and epitaxil growth and deposition.

b. Strong Technologies

(1) Combustion/Heat Transfer - Physical mechanisms, materials, and chemical/thermodynamic properties that control heat transfer.

(2) Chemical Energy Sources - Technologies associated with the development of high energy heat sources for unique smoking articles.

7. Information and Communications

Information and communications technologies are those enabling technologies that affect our approach to data storage and retrieval, simulation, information dissemination, and computing.

a. Emerging Technologies

(1) Computer Simulation and Modeling - The use of computers to replicate, predict, and simulate the behavior of a physical system.

(2) Signal Processing - Consists of signal conditioning (correction of electrical impulses by the elimination of noise) and signal processing (evaluation of corrected signal for decision making or display). The recent development of chip level sensors has integrated the signal processing into the sensor itself.

(3) Measuring and Sensing - Development of techniques using sensors to measure and identify environmental variables (voltage, position, temperature, pressure, physical state, concentration of specified compounds).

b. Strong Technologies

(1) Math Modeling - Modeling using principles of physics, thermodynamics, chemistry, and mathematics to test systems prior to design and manufacture. Computational fluid dynamics, finite element modeling, and regression analysis are a few examples in use.

(2) Consumer Behavior Prediction - Psychophysical models of subjective response; theories of market dynamics; and consumer testing methods.

(3) Neutron Radiography - Thermal neutron imaging of cigarettes and smoke for product and combustion studies.

(4) Data Storage and Peripherals - Data storage conversion of magnetic devices to optical compact disk read-only-memory (CD-ROM), write-once read-only-memory (WORM), and other rewritable storage media for computers. In addition, the development of technologies that transform current input/output hardware (keyboards, mice, light pins, printers) to voice recognition systems, 3D imaging devices, or music synthesizers. Storage and peripheral technologies will be the limiting factor in our ability to model, archive information, and interact with computers.

C. PM USA Technology Management

In order to further refine the technology needs of PM USA considerable effort was devoted to working with both the R&D senior technical staff and R&D management in order to identify technologies considered to be essential to the accomplishment of current R&D

programs. Technologies identified include, in order of importance as determined by the number of individuals identifying a particular technology, the following:

1. Environmental issues/control of emissions
2. Mathematical modelling
3. Sensory technology (chemical senses)
4. Vision and/or optical systems
5. In situ process control
6. Manufacturing technology
7. Information management
8. Technology required for Project Beta
9. Packaging technology
10. Robotics
11. Selective filtration
12. Cigarette burn rate control

There are few surprises on this list, and current R&D projects already incorporate many of these technologies. Knowing what technologies we require, however, leaves several important questions unanswered, such as: Is the in-house development of these technologies sufficient to meet R&D needs? Is there new technology in these areas being developed outside which we need to bring into R&D? If additional resources need to be devoted to any of the above technologies, how are priorities established?

It is actually the last of these three questions which needs to be addressed first, and in order to appropriately prioritize PM USA's technology requirements, it is essential to involve the entire Operations Department. As a consequence, a cross-functional Operations Technology Assessment Committee was formed in late 1992. The mission of this Committee is to:

1. Identify areas of improvement within the respective functional areas that impact the product.

2. Categorize the areas for improvement utilizing the framework discussed in Section B above.

3. Develop a prioritized list of technologies to pursue.

4. Present recommendations to management.

5. Incorporate technology needs into R&D Strategic Plan and the PM USA Operations Plan.

6. Monitor current initiatives.

Technology needs will be ranked according to a number of key qualities possessed by the project(s) requiring the technologies. These qualities include merit of the project, durability of competitive advantage, cost of research, cost to implement, and product horizon. The membership of the Committee is listed in Table VII (p. 87) in the PM USA 1992-1996 R&D Strategic Plan.

D. PM USA R&D 1991 Technology Achievements

1. Domestic and Export Product Development

   a. Merit Ultima and PM Extra Lights - Italy

      (1) Paper core concentric dual filter
      (2) High chalk paper for puff count control

   b. Lark combining wrap

2. Paper Technology

   a. Single wrap for Superslims
   b. Proprietary Low Sidestream inorganic fillers prepared using sol-gel technology

3. Beta

   a. Phase I electronic devices
   b. Half-size devices
   c. Subjective program - optimization of materials, components, and energy input

4. NET

   a. Batch process
   b. Vapor phase reordering
   c. Continuous NET pilot plant

5. New Primary Processing - Direct cylinder conditioning

6. Cast Leaf

   a. Cast Leaf pilot plant
   b. New Blended Leaf (NBL)
   c. Cast Leaf sheet with guar gum

7. Project Tomorrow

   a. Computer program for correlation of mass burn rate with cigarette construction parameters
   b. Printing of colloidal cellulose bands with rotogravure press
   c. Technology to determine dynamic mass burn rates

8. Environmental Support

   a. Project Grain
   b. Humectant reordering

9. Optical Processing

   a. Osiris pack inspection technology
   b. Web inspection device

E. Leveraging PM Companies' Technology Base Through Technical Synergy

The PM Companies Technical Synergy Group was initiated in 1988 shortly after the purchase of General Foods. The mission of this group was to increase effectiveness and reduce costs of R&D throughout PM Companies wherever possible through well-designed interactions among all of the technical centers. The Committee was composed of representatives from each PM Company laboratory, and the group was expanded when Kraft was added to the company. Current membership consists of Charlie Adamo from KGF International; Manuel Bourlas from PM International; Charlie Cante from GF USA; Jim Charles and Ken Houghton from PM USA; Rick Guardia from KGF Scientific Relations; Ron Harris from Kraft USA; Darrell Medcalf from KGF Technology; Art Rehberger and Ken Wendt from Miller Brewing; Paul Roehrig from Oscar Mayer, and Danny Strickland from KGF FPG. Chairman of the Committee is Bob McVicker, KGF.

There have been a significant number of technical synergy interactions involving PM USA during 1991. Formal interactions include a two-day symposium in the fall covering the topic, "R&D in the 90's and Beyond;" one "mini symposium" in August dealing with analytical chemistry; and three meetings of the PM Companies Technical Synergy Committee. Informal interactions also took place. Individuals from Jacobs Suchard and KGF Coffee visited PM USA R&D and took part in a number of technical discussions. Particular interest was shown in the Paper Technology and Sensory Technology Programs. A presentation was made at Kraft USA by an individual from PM USA dealing with the application of neural networks in consumer testing studies; and a talk was given at PM USA by an individual at Kraft USA on product testing strategies.

A number of cross-laboratory projects were completed in 1991. Pilot studies were carried out at PM USA investigating the feasibility of extracting fat with supercritical carbon dioxide from peanuts, chocolate and coconut. Promising results were obtained, and Kraft personnel plan to continue the work with peanuts in their own facilities. Analysis of vanillin obtained by microbial techniques at GF USA was conducted to determine both the level and identity of possible impurities using the tandem mass spectrometer at PM USA. Data were obtained at the GF USA environmental laboratory for a PM USA study on OV changes in cigarettes exported to certain markets. Work was also carried out by the KGF USA binder group in collaboration with PM USA personnel for the Cast Leaf Program.

Other interactions include a visiting scientist from Miller Brewing who spent all of 1991 working in the Biochemical Research Division; information was submitted to Miller Brewing dealing with the PM USA R&D Strategic Planning Process and the Technical Ladder; and both Kraft USA and GF USA Technical Information personnel interacted with the PM USA CI Task Force. The two last interactions to be discussed are perhaps the two most far-reaching examples. A crop protection agent data base was established in conjunction with Shook, Hardy, and Bacon. This data base is being administered by the Technical Synergy Committee, and serves all of PM Companies. Lastly, the PM USA patent data base was completed, and it will be incorporated into a PM Companies patent data base.

The Technical Synergy Committee will continue to be an integral part of PM Companies technology management strategies in 1992. A meeting of the Committee is planned for February, 1992, and at least five major topics will be on the agenda. These topics are: 1) how better to develop PM Companies' technical and management talent within technology functions worldwide; 2) techniques for increasing the ease and effectiveness of technology and idea transfer across company lines: 3) the needs and development of long-term research programs; 4) the advisability of forming macro strategic alliances; and 5) determining how to administratively handle joint programs. In addition, one symposium is planned for 1992, to be held in the fall, with the most likely subject being the environment and related issue.

A great deal has been done in the area of technical synergy since the initiation of the Technical Synergy Committee. However, a great deal more can be done. There are clearly a number of barriers to obtaining the maximal benefit from technical synergy within PM Companies. It should be an objective of the PM USA Technology Assessment function to identify these barriers so that action can be taken to eliminate them.

E. Political and Social

1. Introduction

There are a number of pressing issues facing PM USA during the plan period in the political and social arena. Some of these can be addressed by R&D programs, while others require solutions that will come from other departments in PM USA. The topics to be discussed below are smoking restrictions and ETS, ignition propensity, potential legislated marketing restrictions, the Kennedy Bill, ingredients, discrimination in the work place, excise taxes, liability suits, international tar and nicotine levels, and smokers' and non-smokers' attitudes.

2. Smoking Restrictions and ETS

This is without question the most important political issue PM USA will face during the plan period. At the request of the EPA a report was prepared by a Scientific Advisory Board to review evidence on the alleged health effects of ETS. The draft of this report states that involuntary exposure to tobacco smoke causes lung cancer in non-smokers and increases risk of respiratory illness in children. It also states that ETS should be classified as a known human carcinogen, and that work place smoking policies should reflect the hazard.

The study has not yet been released by the EPA; however, it is likely that it will be released in the near future. Should this report be issued, the next step in the process would involve the Labor Department's Occupational Safety and Health Administration (OSHA). As the report presently stands, OSHA would have no choice but to develop work place indoor air quality standards for ETS. It is likely that many companies will simply ban smoking on the job rather than invest the necessary money to revamp their air-handling systems to comply with OSHA regulations. This would result in a rapid increase in areas in which smoking is restricted.

Even without the issuance of the EPA report, smoking restrictions continue to increase. Currently 26 states and more than 300 localities have enacted laws to restrict smoking in restaurants. Twenty-eight states and approximately 300 localities have enacted laws governing smoking in the work place. Sixty per cent of all US companies now restrict smoking, up from 16% in 1980. One quarter of 283 companies surveyed in 1989 by the Administrative Management Society were smoke free, up from 14% in 1988.

3. Ignition Propensity

The Fire Safe Act of 1990 is now law. It was passed and funded on August, 1990. It is anticipated that NIST will have developed a standard test method to determine

ignition propensity by the end of 1992. R&D currently has significant resources devoted to addressing the ignition propensity problem. Several approaches are being pursued concurrently; however, there is no way to monitor progress until NIST issues its report on a test method.

4. Marketing Restrictions

Several types of marketing restrictions are possible results of government action on the local, state, and national level. These are banning or restricting outdoor and point of sale advertising, prohibiting sampling, and severely restricting vending machine sales. Proponents of these restrictions use the youth and smoking issue to advance their legislative agenda.

It is highly unlikely that there will be a broad-based advertising ban on tobacco products in the US during the plan period. There has been some modest effort to restrict certain types of advertising on the state and municipality level. Currently only one state (Utah) and 11 municipalities restrict outdoor advertising. Outdoor advertising bans were recently repealed in Iowa and Boston, MA. Twenty-nine bills are currently pending in states and municipalities.

The situation is quite volatile at the present time on the international scene. A Quebec court recently ruled that the advertising ban in Canada, which had been in force for three years, was unconstitutional. The government will appeal this ruling, and the advertising ban will remain in effect during the appeal process. Although there was considerable pressure within the EEC to ban advertising in 1992, the objection of Britain, Denmark, Germany, and the Netherlands appears certain to derail this action for the time being.

There is more activity within the US regarding sampling and vending machine sales. This activity is supposedly dictated by concerns over cigarette purchases by minors. Four states, California, Maine, Nebraska, and Utah, ban or severely restrict sampling as do 29 municipalities. Twenty-one bills are pending in municipalities. There has been a substantial increase in the introduction of state and local legislation to restrict or ban sales through vending machines in the late 1980's. Twenty-four states and the District of Columbia considered vending machine legislation in 1990, of which 16 were defeated. Five states and the DC have legislation pending. Three states, Alaska, Minnesota, and Indiana, passed sales restriction bills. Local ordinance proposals appear to be a serious threat for the future. Restrictions on the sale of tobacco products, primarily vending related, were proposed in 133 localities in 1990. Measures were adopted in 56 cities. Most notable are New York City, Westchester County, Pittsburgh, Houston, and Sacramento.

Restriction of sales to minors has now been adopted almost universally in the US. Forty-four states impose a minimum age, from 16-19, for the sale of cigarettes.

5. The Kennedy Bill

The Kennedy Bill, officially known as the Tobacco and Health Protection Act of 1991, was introduced by Senator Kennedy and 19 co-sponsors in June, 1991. At the present time this bill has been referred back to committee, and it will definitely not be acted on by the full Senate in 1991. However, there is a strong likelihood that at least some of the bill's proposals would be voted into law during the plan period. Several of the current proposals appear to be extremely unpalatable to the industry. The bill recommends that a Center for Tobacco Products be established and funded with $75 million for anti-smoking counter advertisements and to fund state enforcement of minimum age and vending machine laws. Such an expenditure would be a waste of taxpayers' money which would accomplish nothing except to provide anti-smoking zealots in state legislatures with sufficient funds to cause problems for the industry. There is a requirement that companies disclose on packages or in package inserts tar, nicotine, and carbon monoxide levels, as well as all ingredients except spices, flavorings, fragrances, and colorings. There is some concern at this time that flavorings, etc., could only be listed on a collective basis if they were natural. At this time, however, this does not appear to be the case. Lastly, there is a requirement to increase the warning label to 20% of the panel space, both front and back. Should this stipulation become law, it would severely limit our ability to create attractive packaging.

6. Ingredients

Domestic issues regarding ingredients have already been covered (see above and Appendix E). There is, however, a major issue which is international in scope; namely, what regulations will the EEC adopt following harmonization in 1992. Although there is no way of answering this question with certainty at this time, the most likely scenario is that the current German regulations would be adopted with minor modification or revision. A less likely alternative is that a list of permitted substances would be developed.

7. Discrimination in the Work Place

This issue is a relatively recent one. In the past several years there have been a number of companies and municipal agencies which have prohibited their employees from smoking off the job. Three states have adopted laws permitting employers to discriminate against smokers in hiring certain state or municipal workers; namely, Massachusetts, North Dakota, and Florida. In contrast, five states enacted employment protection in 1990, and eleven additional states followed suit in the first half of 1991. The current total number of states which has passed legislation protecting employees from such discrimination is 18.

8. Excise Taxes

State excise taxes will continue to increase during the plan period due to two factors. The first is that the organizational anti-smoking movement has made higher cigarette excise taxes an important part of their legislative agenda. The second factor is a consequence of the poor fiscal health of many populous states. In 1990, excise tax increases were proposed in 35 states, of which 8 passed. The 1990 weighted average state excise tax was 23.8 cents per pack, a 1.9 cent increase versus 1989, slightly higher than the average annual increase between 1985 and 1989. Proposals that earmark existing or new tobacco tax revenues for specific state expenditures, such as education and health services, were introduced in 29 states, of which two (Arizona and Florida) passed in 1990. This passage rate of 6.9% is less than half the 1989 level.

The budget accord of 1990 calls for a $2.00 per thousand federal excise tax increase to $12.00 per thousand in 1993. No further federal excise tax increases are anticipated during the plan period.

9. Liability Suits

There has been very little activity regarding liability suits during both 1990 and the first half of 1991. This is because the Supreme Court has agreed to consider the issue of whether the warning label can be interpreted as federal preemption. Although the Court heard the case in late 1991, it re-heard arguments in early 1992.

10. International Tar and Nicotine Levels

No additional countries have passed regulations regarding tar and nicotine deliveries in the past twelve months. Countries which have passed such legislation are restricted to the Middle East and the Pacific Rim. On January 1, 1993, the first round of tar ceilings will go into effect in the EEC. This regulation will limit all cigarettes sold in the EEC to deliver no more than 15 mg ISO tar. A second tar ceiling will become effective in 1998 within the EEC which will limit all cigarettes to deliver no more than 12 mg ISO tar. Considerable work will be needed so that PM International products can meet this ceiling without impairing subjectives.

11. Smokers' and Non-Smokers' Attitudes

A smoker segmentation study suggests that smokers' attitudes are heavily influenced by non-smokers' opinions and actions, which are becoming less favorable toward the industry. Among non-smokers, the percent of anti-smoking "zealots" has been increasing, while the percent of "supporters" has decreased. With respect to smokers, the percent of people who identified themselves as "proud smokers" actually increased (from 15% in 1988 to 16% in 1990), while "self conscious" smokers decreased significantly (from 22% in 1988 to 17% in 1990). This finding suggests an increased in committed smokers that choose not to quit despite

continued social pressures. These findings will have implications for the tobacco industry in terms of potential new product categories. Cigarettes which meet the desires of smokers, while accommodating non-smokers (given that the zealots cannot be accommodated) such as low sidestream products could provide potential volume gains, although products with such attributes have been generally unsuccessful to date.

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D. Suppliers

1. Introduction

Our business depends on a number of direct material suppliers as well as, of course, an adequate supply of tobacco. Direct materials include flavors, adhesives, filter tow, paper, and packaging. In addition we are in the process of establishing relationships with vendors for vision systems using technology developed by PM USA R&D. For some time R&D has pursued a four part strategy with respect to our direct material suppliers: 1) ensure that we can fully specify the materials we buy, 2) ensure that our suppliers respond to PM USA's needs, 3) develop working relationships with our suppliers so that new developments are proprietary to PM USA for a specified period of time, and 4) reduce the number of materials we require whenever possible. In 1990 an additional strategy was added by the formation of the Supply Chain Group. It is the objective of this group to shift the responsibility of direct materials' quality assurance from PM USA to the actual vendor. Current status with respect to our suppliers is briefly summarized below. A detailed report on current status is given in Appendix E.

2. Flavor Suppliers

The objectives of the Flavor Specification Group has been completed. During the last several years over 600 flavor formulations have been thoroughly analyzed, and specifications have been established. All flavors currently in use meet German Food Law regulations. The responsibility for analysis of current flavors has been shifted from R&D to the Flavor Center. R&D will continue, however, to analyze and establish specifications for new flavors.

Work continues in reducing the number of flavor ingredients currently in use. The continuing goal is to reduce the number of ingredients we use by about 2-3% per year. The number of ingredients on the list submitted in December, 1990, was about 500, and we expect to have this number reduced to 485 when the new list is submitted this December.

There are two recent concerns brought about by outside events. The first involves the possibility that at some time in the future PM USA's products will be required to carry labels listing ingredients. The only current bill before Congress as this time is the Kennedy Bill. Under the present terms of this bill, all ingredients could be grouped together and labelled as either spices, flavorings, fragrances or colorings. Our current interpretation of the bill is that both natural and synthetic ingredients would be treated similarly. If, however, this interpretation is not correct, and synthetic ingredients would have to be listed on the pack by name, PM USA would need to restrict most, if not all, of its ingredients to natural flavors. This would require considerable work. Although the Kennedy bill will not be passed this year, this situation needs to be closely monitored.

The other concern involves the fact that there has been a considerable amount of merger and acquisition activity within the flavor industry. Although the possibility exists that a significant decrease in the number of flavor houses we do business with might have an impact on our ability to purchase the ingredients we need, this possibility appears to be quite remote.

3. Filter Tow Suppliers

PM USA obtains virtually all its filter tow from two domestic suppliers - Hoechst Celanese and Eastman. Celanese has become the first supplier with whom PM is partnering. They scored the highest of all PM USA suppliers as measured by the supplier certification program. As a spin-off of the Supplier Partnering program, a joint filter development confidentiality agreement has been approved by both parties. Celanese is continuing to develop their CA web filter material with Kimberly-Clark and Dexter. PM USA R&D is continuing to evaluate materials as they become available, but samples are still unacceptable to date because of high filter RTD variability, subjectives, and the high cost.

PM USA R&D has done little work with Eastman in the past 12 months. At our request, they have produced samples of tow with menthol incorporated into the dope prior to spinning. Although this technology appears to have some benefits with respect to stable menthol delivery, the product would require a dedicated spinning and acetone recovery facility. Eastman continues to develop and offer low dpf tow items, and PM USA R&D has evaluated 1.2 and 1.4 dpf tows. Neither is commercially available, but the 1.4 dpf could be produced commercially if requested. Eastman has declined to support R&D's PM web program as well as a program designed to produce flavor-release agents from cellulose.

PM USA R&D has done considerable work with James River to commercialize a PM web. Celanese is supplying the 1/8" cut cellulose acetate staple for this material. A run at the James River Gouvernor mill in August was successful.

We have initiated discussions with Courtaulds regarding potential materials for PM webs including modified cellulose, CA staple, fibrids, and tencel (a cellulose tow proprietary to Courtaulds). A non-disclosure agreement has been signed, but it is currently being modified to better protect Courtaulds' proprietary information. An exclusivity agreement is being reviewed by them for use of their tencel material. At this time we have not found any of their materials to give us an advantage over the current PM web; however, not all possibilities have been explored.

American Filtrona has been contracted with to manufacture dual paper core concentric filters to support the Merit Ultima program. Production is under way and on schedule.

4. Packaging Suppliers

PM USA deals with a large number of suppliers in the packaging area including 50 ink, coating, and chemical suppliers; 5 paper and board suppliers; 30 converters, 13 of which are considered primary vendors; and 10 miscellaneous suppliers. At the present time confidentiality agreements have been established with 30 of these vendors. A Packaging Materials Chemical Evaluation Project has been established to ensure that all substrates, adhesives, inks, and coatings for cigarette packaging and printed materials meet the following criteria:

a. Environmental regulations which apply to air, water, and solid waste.

b. Freedom from deleterious compounds which are undesirable for product use.

c. Meet subjectively acceptable chemical levels and composition.

PM USA supports this effort through the Packaging Materials Evaluation Committee. Examples of activities related toward meeting our goals in the packaging area include checking formulations of ink systems, coatings, board material, etc. for acceptability; monitoring residual solvents remaining after printing; and determination of heavy metals in packaging materials.

Particular emphasis has been placed on the development of water-borne lacquers and inks in 1991. Originally problems were encountered with printing using water-based systems as well as the tendency of the pigments to rub off after printing was complete. At this time one supplier has developed some satisfactory inks. Current activities with pigments from other suppliers involve removing methyl and ethyl cellosolve from the formulation, and approval of biocides.

5. Paper Suppliers

PM USA R&D continues to work with our two domestic paper suppliers, Kimberly-Clark and Ecusta, as we have done in the past two years. All on-going projects are carried out as joint development projects, and most products developed through these joint development projects are covered by exclusivity agreements.

Our activity with Kimberly-Clark has been primarily in the areas of low sidestream paper, papers to control puff count and ash flaking, and papers for Project Tomorrow. During 1991 a single-wrap was developed for Superslims. Considerable work was devoted to the development of a paper for BOLD which would reduce puff count and eliminate ash flaking. This work led to the qualification of 10-058A paper which is a fast burning paper due to a small increase in basis weight and a significant increase in calcium carbonate level. We have also been working with Kimberly-Clark on two different approaches to Project Tomorrow; namely, off-line rotogravure printing of cigarette paper with colloidal cellulose preparations, and development of equipment to affix small bands of non-porous paper to cigarette paper.

Considerable effort has been devoted during the past year to ensuring that Kimberly-Clark's QA methodology can be correlated with our own paper analyses. A serious discrepancy was discovered in Coresta porosity measurements, and that discrepancy has now been essentially eliminated. A more difficult problem involves the methodology that Kimberly-Clark uses to determine calcium carbonate levels, since it prevents a meaningful comparison to be made between the two QA departments. This situation is unsatisfactory, and negotiations with KC are in progress to solve this problem.

The only current joint development program with Ecusta involves the development of low sidestream papers using magnesite as the primary inorganic filler. This work is currently in progress, and an exclusivity agreement is in place.

6. Adhesive Suppliers

PM USA has recently initiated a project dealing with adhesives; namely, the Adhesive Characterization Project. The objective of this project is to determine the qualitative and quantitative make-up of the adhesives used in PM USA factories in order to develop meaningful specifications and to determine that these adhesives comply with safety and regulatory requirements. We currently purchase adhesives from seven vendors, and we have confidentiality agreements in place with all of them.

The personnel assigned to this project include 3.5 full time personnel in R&D. In addition support from Operations Services, Purchasing, QA, and Manufacturing is provided. The scope of the project during 1992 involves:

a. Complete chemical characterization of adhesives.

b. Characterize pyrolysis products of adhesives.

c. Establish confidentiality agreements with secondary vendors.

d. Reconcile differences between stated components and those found analytically.

e. Determine the regulatory status of components.

7. Vision System Suppliers

The Vision Inspection Technology Project is currently involved with PM-vendor agreements and/or contracts as a result of pack inspection (i.e., Osiris), incoming materials inspection, and 100% web inspection. PM confidentiality agreements are in effect with Dalsa and Quay regarding the 100% web inspection.

Itran is under contract to PM USA to develop a commercial Osiris system according to our specifications. PMA USA owns the Osiris technology and has a licensing agreement with Itran which prevents them from selling systems to companies other than PM in the tobacco or coffee markets. For every system sold by Itran, PM will receive a royalty payment of 8%.

Suppliers

A. Introduction

PM USA utilizes outside suppliers to provide direct materials. The direct materials required for our business include flavors, adhesives, filter tow, various types of paper, and packaging. In addition we are in the process of establishing relationships with vendors for vision systems using technology developed by PM USA R&D. During the past several years R&D has adopted a strategy vis a vis direct material suppliers which stresses four major points: 1) ensure that PM USA can fully specify the materials we buy; 2) ensure that our suppliers respond to PM USA's needs; 3) develop working relationships with our suppliers so that new developments are proprietary to PM USA for a specified period of time; and 4) reduce the number of materials we require whenever possible. In 1990 a fifth point was added to our overall strategy with the formation of the Supply Chain Group. It is the objective of this group to shift the responsibility of direct materials' quality assurance from PM USA to the actual vendor. The current status regarding each type of direct materials is discussed below.

B. Flavor Suppliers

In 1985 R&D established agreements with flavor vendors to permit our receiving qualitative composite disclosures for our compliance with Section 7 of the Labeling Act. In 1986 those agreements were amended to provide for quantitative data on selected ingredients as necessary. In December, 1986, it was decided that R&D will know and be responsible for each and and every Philip Morris ingredient. Therefore, a program was begun to establish exact chemical specifications for each flavor. To facilitate this program, agreements were established with each vendor to provide for semi-quantitative disclosure of ingredients, by flavor, utilizing ranges of <0.1%, 0.1-1.0%, 1.0-10.0%, and >10%. A program was initiated at PM USA R&D, The Flavor Specification Program, to independently corroborate formulations provided by our suppliers, reduce the total number of ingredients (see below), and develop specifications for each flavor we buy. This program was later expanded to include the German Certification Program. This effort ensures that all of the ingredients in the flavors and casings shipped are acceptable under German law. The Flavor Specification Program was completed in the first quarter of 1991, and quality assurance on existing flavors was transferred to the Flavor Center, although the responsibility for establishing specifications for new flavors still resides with R&D.

In addition to our effort involved in establishing flavor specifications, PM USA R&D has also been working for some time to reduce the total number of ingredients we add to tobacco. The rationale for continuing to reduce the number of ingredients we use is a pro-active response to possible government regulations. Such regulations could be targeted on one or more specific

ingredients, or it could be in the form of a labelling requirement. More will be said about labelling requirements later. Since work in this area was initiated in 1986, the total number of ingredients used by PM USA has been reduced 30.4% as of December, 1990. Yearly reductions are as follows: December, 1986, 11.4%; December, 1987, 7.0%; December 1988, 2.2%; December, 1989, 10.4%; and December, 1990, 3.5%. PM USA's current goal is to reduce the number of ingredients by 2-3% each year. The number of ingredients on the list submitted in December, 1990, was about 500, which has been reduced to 490 to date. It is expected that the list submitted in December, 1991, will contain 485 ingredients. In addition work continues on the development of a reduced ingredient Marlboro as well as a "zero" ingredient Marlboro.

There are two specific issues regarding the purchase of flavors that need to be addressed this year. The first involves bills pending in Congress requiring listing of cigarette ingredients on the pack. The critical issue here is, will the bills specify "natural flavor" or "nature identical." The nature identical category is well recognized in Europe and is clearly distinguished from synthetic. Such is not the case in the US. Work has been ongoing for some time to ensure that all ingredients we use in the US are either natural or nature identical. Considerable progress has been made; however, about 2% of the ingredients we use are in neither category. The only bill currently before Congress dealing with ingredients is the Kennedy Bill. Two sections of the bill deal specifically with this subject. One section authorizes the Secretary of HHS to limit or ban the use of any tobacco ingredient. The second would require companies to disclose on packages or in package inserts tar, nicotine, and carbon monoxide levels and all ingredients except spices, flavorings, fragrances, and colorings. Current interpretations of this bill suggest that both natural and synthetic flavorings could be simply labelled as such. However, it still may be possible that synthetic ingredients would have to be listed, by name, on the pack. If PM USA needs to restrict its ingredients to natural flavors, a considerable amount of work would have to be done in a short time. Natural flavors generally contain a large number of minor components which could alter cigarette subjectives. In addition, the cost of flavors would certainly increase because synthetic equivalents are not as expensive as the natural flavor in most cases.

The second issue arises from the fact that in the past eighteen months there has been a significant decrease in the number of flavor vendors due to mergers and acquisitions. Table 1 summarizes this activity. To date there has been no impact of this activity on PM USA's ability to purchase needed flavors and ingredients. We do not anticipate any difficulties in the future even if further mergers occur. Moreover, we should continue to support those vendors that continue to support research into new flavors for tobacco.

Table 1
Recent (18 Months) Merger and Acquisition Activity in the Flavor Industry

Acquiring Company	Acquired Company
Bayer	Creations Aromatiques
Boehringer-Ingelheim	Peter Dreidoppel Essenzenfabrik
Bush Boake Allen	Food Materials
CPL Group	Danco
CPL Group	Berk
Givaudan	Fritzsche
Martin Braun Backmittel & Essenzen	Meistermarken-Werke
Quest International	Sheffield Products
SANOFI	Continental Flavors & Fragrances
Universal Foods	Felton
Universal Foods	Fantasy Flavors
Universal Foods	Williams

What is of concern is the acceptance by the vendors of PM specifications for flavors. For instance, our specifications state that certain antioxidants cannot be used. This has caused difficulty with some flavors where antioxidants have been found, but the vendor states that they have not added them. The vendors claim that they have little influence over their sources for some of the raw materials, and that these unwanted components are being added further back in the supply chain. Considerable work remains to be done before this matter can be resolved. In addition, there is a statement in our specification agreement that requires the vendor to notify PM USA and have our approval before changing sources of raw materials. Many vendors are not happy with this statement, and this may cause them to resist totally accepting PM specifications for flavors.

C. Filter Tow Suppliers

1. Hoechst Celanese

Celanese has become the first supplier with whom PM USA is partnering. They scored the highest of all PM USA suppliers as measured by the supplier certification program. As a spin-off of the Supplier Partnering program, a joint filter development confidentiality agreement has recently been approved by both parties. A first meeting has been held with Celanese personnel in Charlotte, North Carolina, to discuss possible joint projects, and a second meeting is scheduled at Hoechst's Summit, New Jersey, laboratories in the near future.

Celanese is continuing to develop their CA web filter material with both Kimberly-Clark and Dexter. Philip Morris is continuing to evaluate materials as they become available, but samples are still unacceptable to date because of high filter RTD variability, subjectives, and the high cost. We have obtained information indicating that one of our competitors may introduce a product in 1992 incorporating CA web. The filters would probably made by either American Filtrona or Baumgartner. Baumgartner is building a new production facility in North Carolina.

Celanese has reversed their position for the previous year by developing in-house capability to cut cellulose acetate staple at 1/8". They have installed a commercial size cutter at their CelRiver plant, and have produced materials which PM USA has approved for use. They have also supplied PM USA with 40,000 pounds of 1/8" cut staple for PM web development and will continue to support PM in this area. We suspect that since Celanese now has 1/8" staple cutting capability, that they will start to evaluate CA web made with this material.

2. James River

Although James River is a paper company, they are discussed in this section since our chief interaction with them involves a joint project to manufacture PM web for use in filter materials. James River has an excellent research facility in Neenah, Wisconsin, and they have made this facility available to us during the past year for work directed toward the development of PM web. We have been working with the James River Gouverneur mill for several months to carry out a mill run of PM web in order to have sufficient material to make machine made filters and cigarettes. The original run was not successful because of problems with refining of the CA staple as well as dispersion of the furnish. These problems have been solved, and a second run of PM web which took place at the end of August was successful. We have an exclusivity agreement in place with James River which gives us complete ownership of any successful developments resulting from this work with respect to the tobacco industry.

3. Eastman

At the request of PM USA, Eastman has produced samples of tow with menthol incorporated into the dope prior to spinning. The cellulose acetate fibers produced were fabricated into filters which gave cigarettes with stable menthol delivery over time. This process would also eliminate the use of alcohol in our mentholation processes. Unfortunate- ly, this product would require a dedicated spinning and acetone recovery facility at Eastman. Additional work with this material is in progress to determine if there are other methods to accomplish the same results without necessitating a large capital investment.

Eastman continues to develop and offer low dpf tow items, and PM USA has evaluated 1.2 and 1.4 dpf tows. Neither of these is commercially available at this time; however, 1.4 dpf tow could be available in approximately six months after a commitment from PM USA is made.

Eastman has indicated that they will not support our CA staple needs without a long-term commitment from PM. Consequently, our work with them in this area has ended. Eastman also declined to enter into an agreement with PM to jointly develop covalently modified cellulose in order to develop flavor-release compounds.

4. Courtaulds

A trip was made to Courtaulds to review their facilities and capabilities, and further discussions were held in the areas of cellulose modification, CA staple production, web filters, fibrids, and tencel. A non-disclosure agreement has been signed, but it is currently being modified to better protect Courtaulds' proprietary information. Also, an exclusivity agreement is being reviewed by them for the use of their tencel material.

We have requested a number of different types of materials for Courtaulds for the PM web program. They have provided several samples of 3 mm cut staple, but thus far these samples have been unacceptable for making PM web. Their fibrids, in conjunction with cellulose acetate staple, appear to offer webs with higher surface areas than PM webs. To date, however, paper making with this material has not been fully developed because of lack of material. Tencel tow has been requested, but has not yet been received. Samples of de-acetylated cellulose acetate staple have been evaluated as a filter material, but they were found to be subjectively unacceptable. Samples of acetylated cellulose have also been received, but they could not be made into a sheet material. No additional work is planned for this product; however, further research on deacetylated cellulose acetate is still in progress.

5. American Filtrona

American Filtrona has been contracted with to manufacture dual paper core concentric filters in two configurations (100's and king size) to support the Merit Ultima program. Production is under way and on schedule. They are also providing experimental filters to support other programs.

6. Filtrona International Limited

Filtrona International has absolved themselves of all contractual obligations to American Filtrona. They have been supplying filters for PM Super Lights 100's.

D. Packaging Suppliers

PM USA established a Packaging Materials Chemical Evaluation Project to ensure that all substrates, adhesives, inks, and coatings for cigarette packaging and printed materials meet the following criteria:

1. Environmental regulations which apply to air, water, and solid waste.

2. Freedom from deleterious compounds which are undesirable for product use.

3. Subjectively acceptable chemical levels and composition.

The project deals with 50 ink, coating, and chemical suppliers; 5 paper and board suppliers; 30 converters, 13 of which are considered primary vendors; and 10 miscellaneous suppliers. At the present time confidentiality agreements have been established with 30 vendors.

To accomplish these goals a Packaging Materials Evaluation Committee was formalized in July, 1991, consisting of five persons from R&D and two persons from Purchasing Technical Services (PTS). It is the function of this group to review formulations and minimize the time and steps required to recommend components for packaging and, thereby, meet the requirements of manufacturing, marketing, and PM USA's customers. The scope of the project involves:

1. Chemical composition review including primary packaging, promotional items, and tippings.

2. Chemical analysis including solvents by headspace gas chromatography, heavy metal determinations, and pyrolysis (mass spectrometry and infrared spectroscopy).

3. Communications including presentations to QA management, vendor reviews and quarterly meetings, and correspondence concerning specifications, guidelines, and recommendations.

These items require information gathering on components used in packaging items and inks, chemical analyses to determine whether subjective and environmental guidelines are being met, and communication of results and recommendations to line management.

Topics which are addressed include:

1. Materials chemical evaluation.

2. Water-borne lacquers (converted to date - 99.96% of cartons, 99.00% of flip top boxes, and 0% of labels).

3. Water-borne inks.

4. Subjective evaluations and trials.

5. Rotogravure vendor analytical requirements.

6. Lithography.

7. Philip Morris Companies interactions.

8. Computer data and information requirements.

9. Cohesive program for QA, R&D, and PTS.

A number of examples are discussed below.

Formula breakdowns for ink systems, coatings, board material, etc., are submitted to PTS by our vendors. PTS maintains a data base on these materials and assigns test numbers. Actual physical samples are also received when vendors cannot or do not wish to disclose formulations. The formulations and samples are sent to R&D Project 5001, Packaging Studies, which in turn sends them to Analytical Research. The formulations are reviewed, and recommendations are made as to acceptability prior to use by our printers. Samples are submitted to the Materials Evaluation Laboratory, or other appropriate analytical lab, for analysis. Recommendations for these samples are given based on the analytical results. The recommendations are made following PM USA guidelines which cover a toxicological assessment of the compounds, potential disposal problems, and employee safety. The results are reported back to Packaging Studies who reports them back to PTS. If a product formulation has been approved by Analytical Research, it must still pass subjective testing (coordinated by Packaging Studies) and machinability testing before it is qualified for use. In 1990 Analytical Research received over 157 formulations and samples for review. To date over 75 samples have been received this year. PTS received over 800 for consideration in 1990, and 500 have been received year-to-date.

Another aspect of packaging which is monitored is residual solvents which remain after printing. PTS, in conjunction with Packaging Studies, has developed a list of solvents which cannot be used and threshold limits for others. The solvents are monitored on finished packaging using head space gas chromatography. Incoming Materials QA monitors all new brands and selected production brands. Project 6505, Special Investigations, analyzes new formulations before they reach production, and also provides identification of unknowns in new formulations and those found in production runs.

A recently established testing protocol for packaging materials has been for the determination of four heavy metals that were designated by the Conference of Northeastern Governors legislation. Initially, a procedure was developed by Project 1759 which uses energy dispersive X-ray fluorescence to screen packaging for these selected elements. This was not a quantitative procedure, but one which can establish that the levels in the material are below the 600 ppm limit stated by the legislation. An X-ray fluorescence method is now in place which is quantitative. The protocol is to look for any one of the elements chromium, cadmium, mercury, and lead, at a level above 25 ppm or a total above 100 ppm. If either of these situations are encountered, the sample is digested, and the result is confirmed by inductively coupled plasma analysis. To date no samples have exceeded these criteria. Screening of current production will be done by brand family. Three brand families, Marlboro, Lark, and Virginia Slims, have been completed. New brands will be screened as they are received.

Particular emphasis has been placed on the development of water-borne lacquers and inks in 1991. Originally problems were encountered with printing using water-based systems as well as the tendency of the pigments to rub off after printing was complete. At this time three suppliers have developed inks which appear promising; namely, Thiele Enghdahl, Sun Chemical, and DSI. Current activities with pigments from these suppliers involve removing methyl and ethyl cellosolve from the formulation, and approval of biocides. It should be noted that water-borne inks still contain organic solvents. The major difference is that water is added at the press to control ink viscosity rather than organic solvents.

E. Paper Suppliers

We continue to work with our two domestic paper suppliers, Kimberly-Clark and Ecusta, as we have done in the past two years. All on-going projects are carried out as joint development projects, and most products developed through these joint development projects are covered by exclusivity agreements. Our activity with Kimberly-Clark has been primarily in the areas of low sidestream paper, papers to control puff count and ash flaking, and papers for Project Tomorrow.

During 1991 a single-wrap was developed for Superslims. This paper utilizes a high surface area calcium carbonate as the inorganic filler and mono potassium phosphate as the sizing agent. The utilization of the mono potassium phosphate was a discovery made at PM USA R&D, and as a consequence we were able to obtain an exclusivity agreement on this paper from Kimberly-Clark covering a wide range of paper parameters.

Considerable work was devoted to the development of a paper for BOLD which would reduce puff count and eliminate ash flaking. Using information gained from our work on the low sidestream program, we developed such a paper by increasing basis weight slightly and using a very high level of calcium carbonate filler. Because of the fact that there was nothing novel in the papers we designed (only the combination of properties was novel), it was not possible to obtain an exclusivity agreement for these papers. In addition we discovered after our work was completed that Papeteries de Mauduit is marketing a similar paper. As a consequence, three patents were filed covering these papers as the key component of certain cigarette designs.

We have been working with Kimberly-Clark on two different approaches for Project Tomorrow. The first approach is the use of coating papers off-line using a rotogravure technique with a colloidal cellulose slurry. Initial results for these papers have indicted that further work should be pursued. We are currently in the process of working out an exclusivity agreement with Kimberly-Clark covering this technology. The second approach involves a three way agreement among Kimberly-Clark, Molins, and PM USA covering the design and development of equipment to apply strips of non-porous paper to cigarette paper. Kimberly-Clark holds a patent on the paper itself, but was unable to develop the technology for manufacturing the paper.

Equipment to accomplish this was designed and built at PM USA, and Molins is now in the process of investigating techniques for commercializing this equipment.

Considerable effort has been devoted during the past year to ensuring that Kimberly-Clark's QA methodology can be correlated with our own paper analyses. A serious discrepancy was discovered in Coresta porosity measurements, and that discrepancy has now been essentially eliminated. A more difficult problem involves the methodology that Kimberly-Clark uses to determine calcium carbonate levels. In almost all cases the data they report are based on an on-line Measurex technique which makes it impossible to compare methodologies on specific paper samples. This situation is unsatisfactory, and negotiations with KC are in progress to solve this problem.

Agreement on compatible QA techniques is extremely important with regard to a current project which has as its objective the establishment of meaningful cigarette paper specifications. Current specifications allow rather wide tolerances, particularly for porosity and calcium carbonate. Work has been completed to establish specifications for 1-2 mg tar delivery products and is in progress for full flavor delivery products. In addition we have signed a confidentiality agreement with all our paper suppliers (Kimberly-Clark, Ecusta, and de Mauduit) under which they are providing us with the identity of all additives used in the manufacture of cigarette and tipping papers. Kimberly-Clark has completed supplying all information, and no problems have been encountered. DeMauduit has supplied some information; however, the process is not complete. Ecusta has supplied us with all the necessary information, and evaluation of this information is in progress.

The only joint development program with Ecusta involves the development of low sidestream papers using magnesite as the primary inorganic filler. This work is currently in progress, and an exclusivity agreement is in place. We had been working with Ecusta on the use of their vanillin-release compound for the Ambrosia I program. However, existing agreements with RJ Reynolds has caused them to cease collaborating with us in that area.

F. Adhesive Suppliers

PM USA has recently initiated a project dealing with adhesives; namely, the Adhesive Characterization Project. The objective of this project is to determine the qualitative and quantitative make-up of the adhesives used in PM USA factories in order to develop meaningful specifications and to determine that these adhesives comply with safety and regulatory requirements. We currently purchase adhesives from seven vendors. Three of these, Ajax, Fuller and National, are major suppliers. Findley and Upaco provide significantly fewer adhesives, and we purchase only one adhesive each from Eastman and Polymer. These adhesives are used for tippings, cigarette sideseams, labels, blanks, innerframes, stamps, carton

ends, carton top flaps, case packers, plug lap seams, tow anchors, combiners, and tear tape. All adhesives used as of June 27, 1991, listed by PM USA factory are shown in Table 2.

Confidentiality agreements are now in place with all seven vendors. These agreements disclose specific formulation information. However, each adhesive vendor has one or two tiers of secondary suppliers of components. Agreements are not yet in place with these secondary suppliers, with the exception of those cases where a primary supplier is also a secondary supplier to other vendors we deal with directly.

To characterize those adhesives currently in production use, four persons in the Analytical Research Division and approximately 0.5 additional R&D personnel are committed to the project for 1992. In addition support from Operations Services, Purchasing, QA, and Manufacturing is provided.

The scope of the project during 1992 involves:

1. Complete chemical characterization of adhesives.

2. Characterize pyrolysis products of adhesives.

3. Establish confidentiality agreements with secondary vendors.

4. Reconcile differences between stated components and those found analytically with the vendors.

5. Determine the regulatory status of components.

The project is scheduled to be completed in the first quarter, 1993.

G. Vision Systems

The Vision Inspection Technology Project is currently involved with PM-vendor agreements and/or contracts as a result of pack inspection (i.e., Osiris), incoming materials inspection, and 100% web inspection. PM confidentiality agreements are in effect with Dalsa and Quay regarding the 100% web inspection. Dalsa has sold us tunable diode laser cameras. Quay has provided us with expertise in imaging acquisition and data handling.

Itran is under contract to PM USA to develop a commercial Osiris system according to our specifications. A PM confidentiality agreement is in effect with Itran. Engineering is responsible for monitoring the development effort by Itran. PM USA owns the Osiris

technology and has a licensing agreement with Itran which prevents them from selling systems to companies other than PM in the tobacco or coffee markets. For every system sold by Itran, PM will receive a royalty payment of 8%. The purchase of equipment from DataCube and Matrox has not required the establishment of any type of vendor agreement. These companies sell imaging boards.

Production Service Technology is under contract with PM USA to build a material handling-motion control system designed to our specifications. This system will be part of the incoming materials inspection system being developed in the project. A PM confidentiality agreement has not been necessary.

B. Competitive Analysis

1. Introduction

The three competitors we continue to monitor closely are R. J. Reynolds (RJR), Brown & Williamson (B&W), and Japan Tobacco (JT). These three companies have been selected because they have sufficient resources to compete with PM USA in developing new technology, as opposed to the remaining domestic cigarette companies. A summary of their activities during the past twelve months is given below. A detailed analysis of these three companies can be found in Appendix D. As a consequence of PM USA's recent interest in American Brands, it is also discussed in Appendix D.

2. R. J. Reynolds

RJR has been particularly active during the past twelve months. The cause of this activity may be a result of the fact that Reynolds' sales have declined significantly during the first six months of 1991. Total sales have decreased by 6.96 billion units, and the decline in their full margin brands is particularly large (see above).

Reynolds has introduced three major new packings - Camel Ultra Lights, Camel 99's Hard Pack, and Winston Ultra Lights Box. In addition, the Horizon test market was expanded to include two additional locations, St. Louis, Missouri, and Dallas, Texas, while the Dakota test market was extended to Arizona. New packaging, a slide box, is being used in the Arizona test market. They continue to aggressively pursue market share not only through couponing, but also through repositioning brands to lower price tiers. Both Sterling and Magna have recently been reclassified as sub-generics, and Doral is being offered at a sub-generic price point to certain outlets in Texas and New England. Perhaps the most significant activity from Reynolds - as well as the least explicable - concerns changes to a number of their brands starting in December, 1990. A number of examples are discussed below, and the complete data are tabulated in Appendix D.

In January, 1991, data were obtained from routine monitoring of competitive brands in the Cigarette Testing Services Division that Reynolds had made major changes to both Winston 85 SP and Winston Ultra Lights 85 SP. Although it appeared initially that the changes in Winston 85 were solely a result of a decrease in ET from 12 to 7%, the accompanying changes

in Winston Ultra Lights 85 SP, as well as further brand changes later in 1991, would seem to weaken this hypothesis. In addition to the above-mentioned ET change, Winston 85 increased in tar delivery from 15.6 to 19.3, nicotine delivery from 1.07 to 1.56, and puff count from 8.3 to 9.9. Tar/puff remained about constant, but nicotine/puff increased significantly. Tobacco weight increased by 40 mg. Changes made to Winston Ultra Light 85 SP were somewhat different than those made to Winston FF. Although both tar and nicotine deliveries were increased, the increases were modest - from 5.7 to 6.4 for tar, and 0.48 to 0.53 for nicotine. However, puff count increased from 6.7 to 8.5 and tobacco weight increased by 71 mg - more than 12%. The level of ET decreased from 21% to 16%.

In April, 1991, significant changes were made to Winston 100 SP, Winston Lights 100 SP, and Vantage 100 SP. As can be seen by inspection of the Table in Appendix D, there seems to be no consistent objective for these changes. In June, 1991, the Doral family experienced significant changes. Once again, the explanation is not obvious.

Although there is no consistent thread running through the changes discussed above, in most cases both puff count and tobacco weight increased. Either or both of these changes could have been done to increase product quality. If this is the case, however, Reynolds does not appear to be taking advantage of the changes in their sales or marketing campaigns. The most likely explanation at this point in time is that the changes are a result of Reynolds' requirement to keep costs constant despite increasing tobacco weight. This objective can be accomplished only by significant changes to the blend which, in turn, would result in significant changes in cigarette performance. That Reynolds has bought large amounts of low-cost tobacco has been confirmed. However, we do not know enough about the properties of these tobaccos or the detailed blending information to be able predict how cigarette performance might be affected.

There is one possible rationale which must be considered for the changes referred to above; namely, that these changes are preparatory for the introduction of products which potentially could meet the requirements of an NIST ignition propensity test. A well-tested approach to reducing mass burn rate is through the use of a less porous paper. This, of course, would lead to products with increased puff count. If RJR is already marketing products with an increased puff count, than there is one less change which consumers would have to adapt to if a low ignition propensity cigarette had to be marketed. This possibility is perhaps supported by other information we have received regarding Reynolds' activities during the past year (see Appendix D).

RJR made one other noteworthy product change in 1991 - the introduction of "The Wrap." A metallized overwrap was introduced on Winston in the third quarter of 1991, ostensibly to maintain product "freshness." This innovation was well-received by Winston smokers; not so much because they feel that it solves a real product problem, but simply because

it is a positive change, and Winston smokers feel that Reynolds did something for them. "The Wrap" was recently extended to Salem, and RJR has plans to extend it to Vantage in 1992.

Reynolds' position would appear to be quite vulnerable at this time. They are suffering sharp decreases in sales, their new product strategy does not appear to be successful, significant changes to existing products could result in causing their customers to switch to other brands, their percentage of products sold with coupons is the highest in the industry, and they are not particularly well situated to take advantage of growth in the international market. As a consequence of all of the above, it would seem reasonable to recommend that PM USA adopt an aggressive strategy vis a vis Reynolds' brands. We have already completed product development work in the area of ultra low delivery products which will force Reynolds to protect Now. We should be equally aggressive in developing a strategy to take share from Salem.

3. Brown & Williamson

As was the case with R. J. Reynolds, the first six months of 1991 have been difficult for Brown & Williamson. B&W no longer has a dominant full margin brand. Kool, still their largest brand, experienced a sharper percentage decline during this period than any other major full margin brand. Market share went from 4.8 in the first half of 1990 to 4.1 in the first half of 1991. In addition it has gone from the fourth largest selling full margin brand to the sixth largest. Both Newport and Camel currently outsell Kool. Most of their new product activity has been involved in the price value area. They have extended the Raleigh Extra line, which was recently repositioned as a sub-generic. They have also introduced new box packings of Barclay King Size, and Viceroy and Viceroy Lights King Size. At this time it would appear that there is little reason for PM USA to compete directly with B&W domestically. B&W is, however, continuing to build its export business. In addition they have recently announced plans to "revitalize" the Kool franchise through both new line extensions and a new marketing campaign. Because of PM's relatively low participation in the menthol market, this activity would constitute a bigger threat for R. J. Reynolds and Lorillard than for PM.

Perhaps the biggest threat from B&W and BAT, however, is their patents. BAT's three laboratories (B&W, Louisville; BAT, UK; and BAT, GmbH) continue to patent aggressively. Many of their patents during the past twelve months are concept patents, which are defensive rather than offensive in nature. Unlike previous years their patents do not seem to be concentrating on technology to increase quality and manufacturing efficiency. There has been considerable activity in the area of tobacco processing, they have patented a number of novel concepts in the area of Premier type articles, and they continue to be active in the area of low sidestream cigarettes. These patents often have broad, vague claims which could pose problems for new PM USA technology in the future. We need to be cognizant of this challenge, and tailor our own patent policy accordingly.

4. Japan Tobacco

New product introductions in Japan have significantly declined in 1991. JT introduced four new packings in the second half of 1990, but only two new packings in the first half of 1991. Brand switching in Japan has declined significantly, and the growth of the imported segment is slowing. In order to improve their competitive position in Japan with respect to US manufacturers, JT has significantly increased their box packing capacity. It is important to note that JT does appear to be pursuing their export business quite aggressively. Their plan is to increase export sales by 20% per year. Export sales increased from 6.3 billion units in 1989 to 7.2 billion units in 1990. Export sales in 1991 were only 7.5 billion, only a 4% increase and well below the projection of 8.1 billion units. They have recently completed an agreement with Rinsoz & Ormond, a Swiss manufacturer, to produce Mild Seven cigarettes for export to Taiwan. Initial shipments will be limited. They have also increased their shipments of Mild Seven cigarettes to the United States. JT Engineering is presently constructing a primary processing plant in China in order to lay the groundwork for ultimately marketing their products in this vast market.

JT plans to increase its activity devoted to pharmaceutical and biotechnology research. The company plans to build a basic research center in Yokohama in the spring of 1992, and construct an advanced pharmaceuticals laboratory in Osaka. In addition to increased R&D capital spending, JT is sharply increasing its R&D budget. It is estimated that R&D expenses will be $175 million in fiscal 1991 up from $130 million in fiscal 1990. It is assumed that most of this increase will be for pharmaceutical research.

JT continues to pursue an aggressive, long-term technical diversification strategy. During fiscal 1990, the firm extended its food and beverages operations, and began manufacturing and selling vending machines. Two subsidiaries were established: JT Kokubu Ltd., a food products distribution firm, and JT Nifco Co. Ltd., which is involved in industrial plastics production. In addition, JT has entered into an agreement with still another US biotech firm, Cell Genesys, Inc. The numerous JT research laboratories continue to patent and publish high quality technical research.

JT remains a formidable competitor in Japan, and may become a formidable competitor in other parts of the world. Although there is good reason to believe that their long-term strategy is to grow through diversification, they have no intention of abandoning their cigarette business. Because of the fact that they have committed a large portion of their resources to other businesses, the best approach to competing with them in Japan is through the introduction of products with new technologies which address consumer needs. JT clearly has the resources to match any technologies we are likely to develop and commercialize. However, since they have adopted a defensive posture, it would take them a significant period of time

before they would be in a position to market a new technology product. This time period would provide a significant opportunity for PM USA.

C. Competitive Technology

1. Introduction

A number of patents, both from competitors and suppliers which have issued in the 12 month period between July 1, 1990, and June 30, 1991, disclose technology of interest to PM USA R&D. These patents are noted below. More information on patents from RJ Reynolds, BAT, and JTI can be found in Appendix D.

2. RJ Reynolds

a. US 4,941,485 - Low sidestream wrapper using magnesium hydroxide.

b. US 4,941,486 - Sidestream aroma modification using treated cigarette papers.

c. US 4,947,874 - Battery operated smoking article.

d. US 4,947,875 - Battery operated aerosol delivery device.

e. US 4,962,773 - Expanded tobacco using supercritical propane.

f. US 4,962,774 - Reconstituted tobacco incorporating ammonia.

g. US 4,971,077 - On-line monitoring of menthol using near infra-red.

h. US 4,979,521 - Manufacturing cigarettes wherein water is introduced through the tongue.

i. US 4,995,405 - Manufacturing cigarettes wherein a liquid is introduced into the tobacco.

j. US 4,998,541 - Low sidestream wrapper using magnesium hydroxide and an alkali metal salt.

k. US 5.012,826 - Expanded tobacco using supercritical propane and carbon dioxide.

l. EP 404,473 - Expanded tobacco using sulfur hexafluoride.

m. EP 419,733; EP 419,974; EP 419,975; EP 419,981 - Smokable fillers using tobacco mixed with calcium carbonate, pyrolyzed cellulose, etc.

2. BAT

a. US 4,934,524 - Package for storing cigarettes to maintain moisture level.

b. US 4,938,235 - Device for separating tobacco particles from a tobacco/ gas mixture.

c. US 4,977,908 - Water expanded reconstituted tobacco process.

d. US 4,986,287 - Coaxial cigarette which changes mass burn rate without changing static burn rate.

e. US 5,024,351 - Coupon dispenser.

f. EP 291,104 - Pectin based adhesive.

g. EP 338,018; JP 02-39,873 - Filters containing carboxylic acids.

3. JT

a. US 5,020,550 - Tobacco expanded with gaseous carbon dioxide.

b. EP 426,069 - Laser perforation of tipping paper.

c. JP 02-152,642 - Equipment to automatically remove cigarettes from pack.

d. JP 02-203,775 - Glucose esters as tobacco flavorants.

4. Eastman Kodak

a. US 4.964,426 - Cellulose acetate filters containing microcrystals of sodium carbonate.

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b. US 4,994,312 - Shaped continuous polymer matrix articles containing polymer microbeads.

5. Hoechst Celanese

a. US 4,971,078 - Filter containing a hollow fiber.

b. US 5,009,239 - Filter containing organic acids.

6. Imperial Tobacco

a. EP 407,022 - Laminated smoking wrapper.

b. UK 2,234,663 - Smoking material containing high alkaloid cultured tobacco cells.

7. Lorillard - US 5,001,951 - Apparatus for cutting apart cigarette packs prior to recovery of the tobacco.

8. Kimberly-Clark

a. US 4,942,077 - Tissue webs having a regular pattern of densified areas.

b. US 4,961,415 - Non-woven filter materials.

c. US 4,973,503 - Filter tow incorporating microfibers.

d. US 4,997,082 - Controlled humidity cigarette pack.

9. Reemtsma - US 4,945,932 - Cigarette which extinguishes using a wrapper with calendered bands.

10. Rothmans

a. US 4,953,570; US 4,967,770 - Cigarette making machine hopper which reduces tobacco degradation.

b. EP 408,354 - Cigarette which decreases in strength as it burns down.

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Competitive Intelligence

A. Introduction

Competition within the worldwide cigarette industry continues to be intense. There has been considerable activity within the United States during the past twelve months with regard to new brand introduction particularly from R. J. Reynolds and the American Tobacco Company. The majority of this brand activity has been in the price value area; however, Reynolds has introduced new packings for Camel, Winston, and Dakota. American Brands has been particularly active, although none of their new brands or packings involves major developments within R&D. Nevertheless, American will be included in this write up along with the three companies that can be considered to have sufficient R&D resources to compete effectively with PM USA. These three companies are R. J. Reynolds, Brown & Williamson (BAT), and JTI.

B. R. J. Reynolds

1. Highlights

As pointed out above, R. J. Reynolds has been quite active during the past twelve months. They have introduced a considerable number of new brands and packings. The most noteworthy of these introductions are Camel Ultra Lights, introduced nationally in January, 1991; the extension of the Horizon test market to St. Louis, Missouri, and Dallas, Texas, in March, 1991; the test market (about 50% of the United States) of Winston Ultra Lights King Size and 100's in a box packing in June, 1991; and the regional introduction in June, 1991, of Camel and Camel Lights 100 in a box packing which Reynolds is marketing as Camel Hard Pack 99. Reynolds has been quite active in advertising this last product with their "Hard Pack" campaign.

In addition to new brand introductions Reynolds has made major changes to many of their brands. In almost all cases these changes involve a reduction of 5% in expanded tobacco, an increase in tobacco weight, and an increase in puff count. In making these changes there are often significant changes in tar/puff and nicotine/puff. This topic will be discussed in considerable detail below. Reynolds has essentially completed the conversion of all their cigarettes from flax paper to wood pulp paper. The only exception is Now. Although this move is primarily in order to decrease costs, they have taken advantage of the fact that wood pulp paper is whiter than flax paper by claiming that Winston, at least, has improved quality. A further change involves a new overwrap for Winston packs. This overwrap is a metallized

film similar to the Premier wrapper, although much thinner, and is being marketed as a quality improvement. Other cost cutting measures include switching completely from glycerine to sorbitol, saving $0.20/lb, and eliminating the use of propylene glycol for pre-conditioning tobacco (1/3 of their total use).

Although much of Reynolds' activity during the past twelve months is clearly driven by a desire to cut costs, some is undoubtedly a result of the fact that sales of their full margin brands are significantly declining. Maxwell data for the first six months of 1991, showed that Reynolds has experienced a decline of 9.1% compared to the same period of 1990. This decline is significantly greater than those experienced by the other domestic companies. Most of this decline can be attributed to the poor performance of Winston, Vantage, and Salem. Reynolds appears to be responding to this market decline by attempting to increase sales through couponing and repositioning branded generics as third tier products. The most noteworthy change is the repositioning of both Magna and Sterling to the third tier category in May, 1991.

2. New Products

a. New Product Introductions - Reynolds has introduced the following new products during the past twelve months.

(1) Sterling 100 Regular and Menthol were introduced nationally in November, 1990. The regular version delivers 16 mg tar and 1.1 mg nicotine, while the menthol version delivers 18 mg tar, 1.3 mg nicotine, and 0.6 mg smoke menthol.

(2) Camel Ultra Lights King Size, Soft Pack and Box, and Camel Ultra Lights 100 Box were introduced nationally in January, 1991. The King Size Soft Pack cigarette is 84 mm with a delivery of 6 mg tar and 0.5 mg nicotine. The King Size Box cigarette is 83 mm with a delivery of 6 mg tar and 0.5 mg nicotine. The 100 mm Box product delivers 6 mg tar and 0.6 mg nicotine.

(3) Dakota King Size and Dakota Lights King Size were introduced in a Slide Box packing in Arizona. These 83 mm products are modifications of Dakota Long Size Box and Dakota Lights Long Size Box. The full flavor delivers 19 mg tar and 1.3 mg nicotine, while the lights product delivers 13 mg tar and 1.0 mg nicotine.

(4) Horizon King Size Regular and Menthol were test marketed in St. Louis Missouri, and Dallas, Texas, in March, 1991. These two cities were added to the original test market in Atlanta, Georgia. Both cigarettes deliver 12 mg tar and 0.9 mg nicotine. The menthol version delivers 0.5 mg menthol. These cigarettes release ethylvanillin into the sidestream through the use of ethylvanillin glucoside coated onto the cigarette paper.

(5) Dakota King size and 100's and Dakota Lights King Size and 100's were introduced in Box packings in Nashville, Tennessee, and Houston, Texas, in June, 1991. Dakota King Size Box delivers 18 mg tar and 1.4 mg nicotine; Dakota 100 Box delivers 17 mg tar and 1.2 mg nicotine; Dakota Lights King Size Box delivers 12 mg tar and 1.0 mg nicotine; and Dakota Lights 100's Box delivers 12 mg tar and 0.9 mg nicotine.

(6) Winston Ultra Lights King Size Box and Winston Ultra Lights 100 Box were test marketed in about 50% of the US in June, 1991. The King Size Box cigarette has a smaller circumference (24.5 mm) than the corresponding Soft Pack cigarette (24.9 mm), and delivers 5 mg tar and 0.5 mg nicotine. The 100's Box packing also has a smaller circumference (24.2 mm) than the Soft Pack (24.9 mm), and delivers 5 mg tar and 0.5 mg nicotine.

(7) Camel 99's and Camel Lights 99's were introduced in box packings in Arizona, California, Idaho, New Mexico, Oregon, Utah, and Washington on July 1, 1991.

In addition to the introductions listed above, RJR has test marketed 83 mm box packings of Camel KS, Camel Lights KS, Magna KS, Magna Lites KS, Winston Lights KS, and Winston KS in a number of cities. These products are expected ultimately to replace the long size box packings.

b. New Brand Performance

It is of considerable significance that all but one of the above new product introductions involve full margin brands. Camel is clearly the best performing of Reynolds' full margin brands, in terms of growth, and therefore it is not surprising that it has dominated new full margin brand activity during the past twelve months. Three packings of Camel Ultra Lights, a new entry in the Camel family, were introduced nationally in January, 1991. It

seems reasonable to assume that this product was introduced to beat Marlboro Ultra Lights to the marketplace. Philip Morris did not counter this introduction, however, as Reynolds may have expected, by introducing the Ultra Lights product nationally, but rather by the national introduction of Marlboro Medium. Based on performance of Camel Ultra Lights to date, it would appear that this strategy was sound in that the brand has not performed particularly well. As of August, 1991, it had a 0.4% share. In fact Camel Ultra Lights is being dropped in some chains within Region 5 (Western US) to facilitate the introduction of Camel 99's (see below).

The strategy behind the introduction of Camel 99's is quite different from that which prompted the introduction of Camel Ultra Lights. Camel has had some success in cutting into Marlboro's share with young adult smokers. Camel 99 clearly intends to build upon this success. Neither Camel full flavor nor Camel Lights has been previously available in a 100 mm box packing. The advertising campaign - The Hard Pack - for this brand is clearly tailored to appeal to young adults. Moreover, the description of the brand as a 99 rather than a 100 mm cigarette is intended to differentiate it from competitive brands and give it an identity of its own. This approach may also appeal to young adults. The status of this new brand in the marketplace should be monitored carefully. Two months after its introduction it had a 0.2 retail share in the western US market.

The second full margin brand which has received considerable attention from Reynolds in the past twelve months is Dakota. Dakota 80 Box and Dakota Lights 80 Box were originally test marketed in Texas and Tennessee in March, 1990, as a potential direct competitor for Marlboro. Reynolds followed up this introduction in January, 1991, with a test market in Arizona of two packings, full flavor king size and lights king size, in a new type of packaging - a slide box. Despite the new packaging, as well as extremely aggressive promotion of the product, Dakota is not doing particularly well in the Arizona test market. RJR is making every attempt to target this product against Marlboro. For instance, there was a "Dakota Profit Plus Program" in effect from February 18 to June 30, 1991. If store personnel are wearing an "Ask Me About Dakota" button, they are paid $5.00. If store personnel get a consumer to purchase Dakota instead of Marlboro in the presence of an RJR salesman, they receive $50.00. In June, packings of Dakota in the original test market sites were increased by adding 100 mm packings for both the full flavor and lights versions. Based on test market results to date for the soft pack entries, this brand would not seem to constitute a threat.

The last product to be discussed is Horizon. Horizon was initially introduced into test market in Atlanta, Georgia, in June, 1990. At that time it was the first attempt to market the concept of "the first cigarette that smells good" in a full circumference presentation. Horizon generates a vanillin-smelling sidestream aroma generated through the thermal decomposition of ethylvanillin glucoside which has been coated onto the paper. Chelsea, a 23 mm product which utilized the same technology, had already been introduced into three test markets. Performance of Horizon in Atlanta was judged to be sufficiently good, 0.4 market share, to warrant the addition of two additional test markets - St. Louis, Missouri, and Dallas, Texas, in March, 1991. It is too early at this time to obtain any meaningful read-out as to how Horizon is doing in the new test markets. Chelsea has not performed as well in test market, and it is being withdrawn. Despite the low market share achieved by Horizon, it is possible that it is high enough to allow Reynolds to profitably introduce this product nationally. If they do go national with the product, it is likely to be some time in late 1992.

3. Changes to Existing Brands

Reynolds has made extensive changes to their existing brands during the past twelve months. The two most significant changes are that they are now using wood pulp paper on all of their brands with the exception of Now, and they have significantly decreased the level of ET in many of their brands. Conversion from flax to wood pulp paper has been phased in gradually, starting in August, 1990, and completed in April, 1991. The change from flax to wood pulp paper is primarily a cost-saving measure. On average, wood pulp paper runs about $0.07 less per thousand cigarettes than does flax. On the other hand Reynolds has utilized the fact that wood pulp paper is whiter than flax paper to promote the image of higher quality for Winston in their advertising. It is interesting to note that we have been able to determine if the wood pulp paper on a Reynolds cigarette is obtained domestically or from a European supplier. Precipitated calcium carbonate can be obtained in two morphological forms - calcite or aragonite. Domestic chalk is always exclusively 100% calcite. Both domestic suppliers take great pains to eliminate aragonite from their calcium carbonate, since aragonite has a greater tendency to dust. European suppliers, on the other hand, use mixtures of the two forms. Most of them prefer to include some aragonite in their chalk because aragonite tends to have greater whiteness. We have picked up both types of papers on Winston in the past few months.

The second major change is the reduction of ET in some of their brands. This change started in late 1990, and appears to be continuing. Reductions are all about

5%, i.e., from 21 to 16%, from 16 to 12%, and from 12 to 7%. Reduction of ET in their brands is most likely a result of the fact that freon 11, the agent they use for expanding their tobacco, must be phased out of use by the year 2000 according to the Montreal protocol. Although they could continue to use it at this time, there are two compelling reasons to attempt to use as little as possible. The first is cost. One result of the Montreal protocol is to impose a tax, which increases each year, on the sale of freon. As a consequence, freon 11 cost has increased in the last year from $0.95/lb to $2.37/lb. The second reason involves potential adverse publicity. The reduction of expanded tobacco increases tobacco weight, and Reynolds has clearly taken a significant weight increase on all brands they have changed to date, in many cases by considerably more than would be expected based simply on the decrease of ET. The additional weight increase may be an attempt to improve quality (firmness), or it may be a consequence of the need to use less expensive tobaccos (see below). The increase in weight would be expected to have a significant cost effect. Some of the cost effect is mitigated by the fact, discussed above, that freon costs have increased significantly. In addition there is information that Reynolds is keeping costs down by the use of less expensive tobacco. Although there is some speculation that Reynolds can afford to use less expanded tobacco because of the large number of steaming tunnels, installed in Tobaccoville when it was built, which allow the total filling power of the blend to be increased to some extent, the fact that they did take significant weight increases suggests that this effect is not large. Lastly, it should be noted that Reynolds has licensed the PM USA DIET process, and should have their own DIET facility on-line in late 1991.

The decrease in ET levels discussed above is not the first major change RJR has made to their tobacco weight and density in the last few years. In late 1988 they took an across-the-board weight increase of about 5%, and in mid-1990 ET on the most of their brands was reduced about 4-5 percentage points. These changes were made with a minimum effect on tar and nicotine deliveries as well as puff count. The current reduction in ET for Reynolds' brands has been accompanied by changes in tar delivery, nicotine delivery, and puff count. Some of these changes are quite significant, and appear to be far greater than would result simply from the changes in ET and tobacco weight. Moreover, there is no consistency in these changes. Tar delivery can increase (Winston 85), decrease (Winston Lights 100 Box), or remain the same (Winston Lights KS Box). Tar/puff either remains the same or decreases. Nicotine delivery tends to follow the same trend as tar delivery, although Winston 85 shows an increase in nicotine/puff. Puff count invariably increases. At this time the logic behind these changes is difficult to understand. As already mentioned, nicotine/puff increases for Winston 85. Could this be an attempt to provide the smoker more nicotine which might be regarded as a competitive advantage? Possibly;

however, no other brand was changed in this manner. The fact that puff count increased might have been an attempt to decrease mass burn rate; however, in most cases the increase in tobacco weight negates the increase in puff count. It does appear that for three brands, there may be a decrease in mass burn rate. An increase in puff count could be a consumer issue; i. e., more puffs for your money. If this is the case, they do not seem to be using it as a marketing tool. However an increase in puff count as a quality advantage has been mentioned by RJR personnel in a number of recent articles discussing these changes. At this point all we can do is monitor the situation extremely closely and continue to obtain more information. Data outlining the changes in cigarette construction and cigarette properties for those brands which have been changed in the past twelve months are given in Table 1.

4. RJR Brand Performance

Reynolds sales, based on the second quarter Maxwell Report, have declined almost 9.1% year-to-date for the first six months of 1991 as compared to the corresponding period in 1990. Although full margin brands, particularly Winston (17.4%) and Vantage (15.8%), have experienced the greatest decline, even Reynolds' price value brands are not performing well compared to the growth of price value overall. RJR's total price value sales increased by 13.0% compared to an increase of 43.0% for the remainder of the industry. The performance of Reynolds' major full margin brands over the past twelve months is shown in Figure 1, while the performance of their major price value brands is given in Figure 2.

In order to attempt to increase market share, Reynolds repositioned both Magna and Sterling as sub-generics in May, 1991. This move will result in the immediate increase in the penetration of this price tier in Nielsen stores from 77% to about 88%. This increase in penetration will bring the segment to environments that thus far had resisted sub-generics, and will likely afford distribution opportunities for other third tier brands, including Bristol. Although this move is a potential threat to PM brands, Reynolds is currently not expending a great deal of marketing effort to promote this repositioning. One step which has been taken to promote these brands in some areas is the use of $1.00 coupons. In some areas Magna is selling for as little as 69 cents a pack and $6.50 a carton.

More surprising than the repositioning of Magna and Sterling is the fact that

Winston, Salem, Camel and Vantage shipped sticks

in 1991

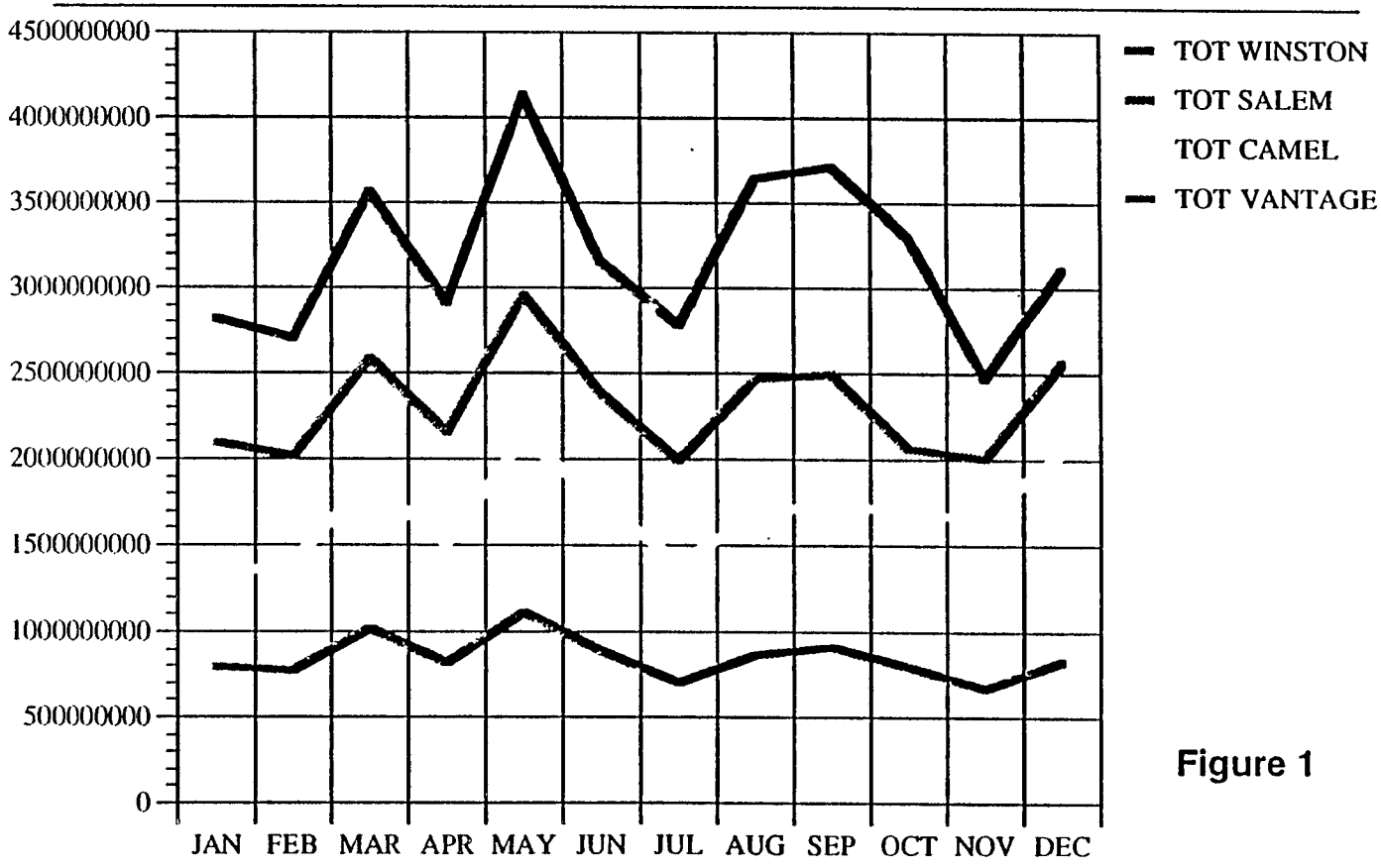

Figure 1

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Doral, Magna Century and Sterling PV shipped sticks in 1991

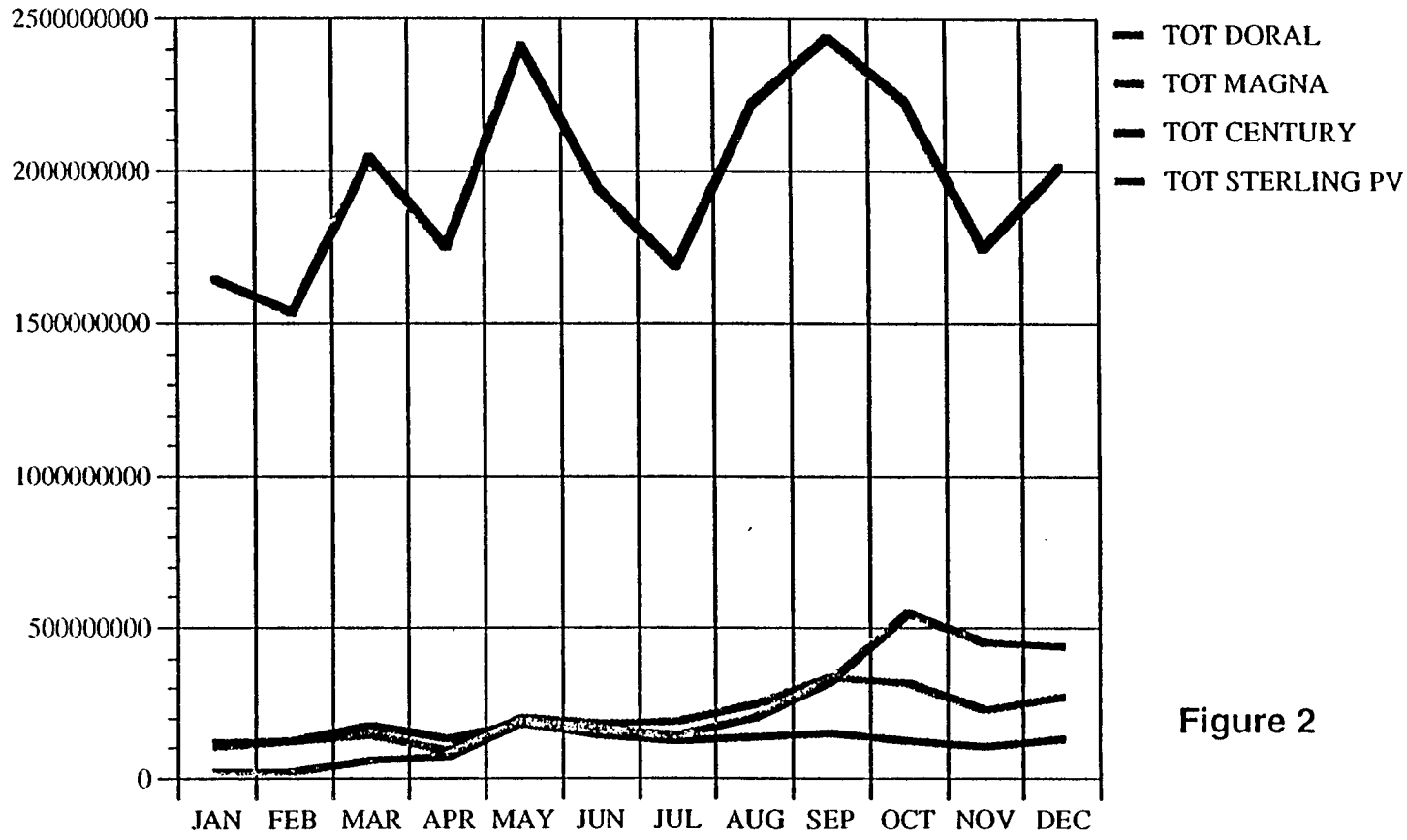

Figure 2

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Table 1
Physical and Smoking Parameters for RJR Brands

Brands Reported in January, 1991

	Winston 85		Winston Ultra Lights	
	Old	New	Old	New
FTC Tar (mg/cigt)	15.8	19.3	6.3	6.4
Nicotine (mg/cigt)	1.09	1.56	0.51	0.53
Puffs/cigt	8.3	9.9	7.1	8.5
Tar/puff	1.88	1.95	0.89	0.75
Nicotine/puff	0.13	0.16	0.07	0.06
Total RTD (mm H2O)	118	98	119	118
Paper component (%)	0.5	0.5	1.2	0.5
Permeability (Coresta)	24	25	25	24
Filter RTD (mm H2O)	78	65	128	128
Fiber denier	3.6	3.1	2.4	2.4
Ventilation (%)	7	18	46	46
Tob. wt. (g)	0.712	0.752	0.605	0.651
ET (%)	12	7	21	16

	More 120		More Menthol 120	
	Old	New	Old	New
FTC Tar (mg/cigt)	15.4	17.5	14.7	18.3
Nicotine (mg/cigt)	1.12	1.28	1.18	1.42
Puffs/cigt	11.4	12.6	11.6	13.1
Tar/puff	1.35	1.39	1.27	1.40
Nicotine/puff	0.13	0.16	0.07	0.06
Total RTD (mm H2O)	167	159	161	156
Paper component (%)	1.2	1.2	1.1	1.3
Permeability (Coresta)	15	16	16	16
Filter RTD (mm H2O)	118	115	117	116
Fiber denier	4.7	5.4	4.9	5.4
Ventilation (%)	31	31	32	30
Tob. wt. (g)	0.721	0.734	0.720	0.738
ET (%)	16	12	16	12

Table 1 - Continued
Physical and Smoking Parameters for RJR Brands

	Doral FF 100		Salem Lights 85	
	Old	New	Old	New
FTC Tar (mg/cigt)	14.4	16.1	9.5	10.4
Nicotine (mg/cigt)	1.03	1.20	0.70	0.78
Puffs/cigt	8.1	8.5	7.1	7.5
Tar/puff	1.78	1.89	1.34	1.39
Nicotine/puff	0.12	0.14	0.10	0.10
Total RTD (mm H2O)	129	129	126	130
Paper component (%)	0.5	0.5	0.9	0.9
Permeability (Coresta)	23	24	37	35
Filter RTD (mm H2O)	83	80	107	110
Fiber denier	2.5	2.5	3.4	3.4
Ventilation (%)	0	0	21	22
Tob. wt. (g)	0.698	0.727	0.633	0.674
ET (%)	25	21	16	12

Brands Reported in April, 1991

	Vantage 100	
	Old	New
FTC Tar (mg/cigt)	9.6	9.4
Nicotine (mg/cigt)	0.75	0.74
Puffs/cigt	9.2	11.1
Tar/puff	1.03	0.86
Nicotine/puff	0.08	0.07
Total RTD (mm H2O)	135	117
Paper component (%)	0.9	0.5
Permeability (Coresta)	37	23
Filter RTD (mm H2O)	121	122
Fiber denier	2.6	2.4
Ventilation (%)	35	51
Tob. wt. (g)	0.771	0.841
ET (%)	16	12

Table 1 - Continued
Physical and Smoking Parameters for RJR Brands

Brands Reported in June, 1991

	Winston Lights KS Box		Winston Lights 100 Box	
	Old	New	Old	New
FTC Tar (mg/cigt)	9.9	9.9	10.9	9.5
Nicotine (mg/cigt)	0.69	0.74	0.82	0.77
Puffs/cigt	7.7	8.8	9.2	10.3
Tar/puff	1.28	1.12	1.18	0.92
Nicotine/puff	0.09	0.08	0.09	0.07
Total RTD (mm H2O)	140	143	145	124
Paper component (%)	0.5	0.5	0.5	0.6
Permeability (Coresta)	27	24	38	41
Filter RTD (mm H2O)	114	117	120	120
Fiber denier	2.1	3.0	3.1	3.4
Ventilation (%)	17	23	19	37
Tob. wt. (g)	0.619	0.693	0.733	0.778
ET (%)	12	7	12	7

	Winston Lights 100		Camel Lights 100	
	Old	New	Old	New
FTC Tar (mg/cigt)	11.2	11.4	11.5	11.4
Nicotine (mg/cigt)	0.83	0.85	0.85	0.84
Puffs/cigt	9.5	10.4	9.5	10.1
Tar/puff	1.18	1.10	1.20	1.13
Nicotine/puff	0.09	0.08	0.09	0.08
Total RTD (mm H2O)	113	113	111	113
Paper component (%)	0.5	0.5	0.5	0.5
Permeability (Coresta)	40	40	38	39
Filter RTD (mm H2O)	91	104	90	93
Fiber denier	2.6	3.3	2.6	2.6
Ventilation (%)	26	33	26	27
Tob. wt. (g)	0.775	0.800	0.771	0.796
ET (%)	12	7	12	7

Table 1 - Continued
Physical and Smoking Parameters for RJR Brands

	Doral KS Menthol		Doral 100 Menthol	
	Old	New	Old	New
FTC Tar (mg/cigt)	16.9	17.3	16.0	16.8
Nicotine (mg/cigt)	1.22	1.25	1.22	1.26
Puffs/cigt	8.2	9.3	8.6	9.6
Tar/puff	2.06	1.86	1.86	1.75
Nicotine/puff	0.15	0.13	0.14	0.13
Total RTD (mm H2O)	105	106	122	122
Paper component (%)	0.5	0.5	0.5	0.5
Permeability (Coresta)	25	25	25	24
Filter RTD (mm H2O)	64	64	74	73
Fiber denier	3.0	3.0	2.5	2.5
Ventilation (%)	8	12	None	7
Tob. wt. (g)	0.665	0.738	0.711	0.812
ET (%)	21	16	21	16

Reynolds is currently bringing Doral to a sub-generic price point in a select group of independent accounts in New England (Maine, New Hampshire, and Massachusetts) and Texas. Payment is made to retailers with either cash or coupons. Whether they intend to extend this strategy or not remains to be seen.

5. R&D Organization

Information obtained from two different sources clearly confirms the fact that the RJR Tobacco Research Center is declining in numbers. Unpublished information indicated a size of 750, which is reasonably consistent with a size of 687 reported in the "Directory of American Research and Technology, 1991." This number has been broken down into 401 professionals, 87 of whom have doctorates, and 286 technicians and auxiliaries. Despite the fact that this number of 687 is published, it is self-reported, and therefore should not be assumed to be exactly correct. RJR recently announced that they had eliminated 200 positions within RJR Tobacco in Winston-Salem. Of the 200 positions, 150 were hourly workers, while 50 were executive and administrative personnel including supervisors, engineers and office staff. One local newspaper indicated that R&D had been particularly hard hit. We have information which indicates that 25-35 of those who were let go came from R&D. Most, if not all of these individuals, were engineers. A large majority of the employees left of their own volition to take advantage of new severance and early retirement benefits. The new terms for early retirement now apply to workers over age 50 with at least 10 years of service. Severance pay was set at two weeks pay for each year of service. In the white collar area, about one-third of those who left did so voluntarily, while the remaining two-thirds simply had their jobs eliminated. Taking this most recent change into account, our current estimate for the RJR R&D staff is about 650. It would appear that the number will continue to shrink, perhaps by as many as 75, in the near future.

Even with the recent cuts within RJR's R&D Department, their staff is still larger than PM USA R&D. It is considerably larger when placed on a per cigarette sold basis. A direct comparison is difficult to make because the numbers quoted do not include any contribution for RJR International. On the other hand, their Research Center does include a "Smoking and Health Group" and Engineering and Leaf functions which are not included in the PM USA R&D Department. These adjustments have been made to obtain a direct functional comparison in Table 2, and the final number is normalized on a per cigarette sold basis. As can be seen from Table 2, the RJR Research Center is still considerably larger than that at PM USA.

Table 2
Comparison of RJR and PM USA Research Center Headcount on an Adjusted Basis

	RJR	PM USA
Nominal	650	577
-RJR Leaf Function (15)	635	577
-RJR Engineering Function (20)	615	577
-PM USA Service to PMI (14)	615	563
+PM USA INBIFO (112)	615	675
Headcount per Billion Units Sold Based on Previous 12 Month Volume	4.17/billion	3.05/billion

One significant change has taken place within the executive management group of the RJR Research Center. Bob DiMarco, Senior Vice President, Research and Development, now reports directly to James Johnston, CEO of R. J. Reynolds Tobacco, rather than to David K. Isbister, Executive Vice President, Manufacturing and Technology. Apparently this change was made at the request of Mr. Johnston to enable him to become more familiar with the RJR Research Center. It is still rumored that DiMarco will retire in late 1991 or in 1992. At present his most likely replacement would appear to be Dr. Gary Burger, Vice President, Advanced Technology Products. Burger's influence within R&D seems to have increased, and there are indications that both Mary Stowe, Vice President, Product & Applied Technology, and Robert Lloyd, Vice President, New Product Technologies, report directly to Burger. Both A. W. Hayes, Vice President, Biological R&D, and W. M. Hildebolt, Vice President, Administrative & Technical Services, continue in their previous positions.

Biological R&D is divided into two Directorates, Biobehavioral & Sensory Evaluation, and Toxicology Research. Biobehavioral & Sensory Evaluation consists of three Divisions: Environmental Tobacco Smoke, Biobehavioral Research, and Sensory Evaluation. Toxicology Research is also divided into three Divisions: Applied Toxicology, Pharmacology Research, and Cellular & Molecular Biology. Management personnel we have identified to date in this area are J. H. Reynolds, Manager of Biobehavioral Research; M. R. Savoca, Manager of Sensory Evaluation; P. A. Crooks, Manager of Applied Toxicology, and J. D. deBethizy, Manager of Pharmacology Research. There are indications that RJR will no longer carry out an active research program in the area of environmental tobacco smoke. Apparently Guy Oldaker, the Senior Scientist in the ETS area, has been requested to find another area of research. The ETS group was a relatively large group consisting of at least twelve individuals, some of whom are quite prominent RJR scientists.

Product & Applied Technology consists of three Directorates, Brands Technology, Brands R&D, and Basic Research. Brands Technology consists of two Divisions: Flavor Technology and Product Design Technology. W. M. DuFour is the Director of Brands Technology, and B. M. Lawrence is the Manager of Flavor Technology. Brands R&D consists of three Divisions: Tobacco Standards, Brands R&D, and Statistics. R. L. Willard is the Director of Brands R&D, J. M. Rivers is the Manager of Tobacco Standards, and L. J. Inman is the Manager of Brands R&D. Lastly, Basic Research also consists of three Divisions: Analytical Chemistry, Aerosol Research, and Chemical Research. J. F. Elder is the Manger of Analytical Chemistry, B. J. Ingebrethsen is the Manager of Aerosol Research, and J. P. Dickerson is the Manager of Chemical Research. It is possible that emphasis on aerosol research at RJR is declining. At least two of the key people in the Division have been moved in